REMARKS/ARGUMENTS

Claim Status

Claims 1, 3-7 and 9-11 are pending. Claims 1 and 3 are currently amended. Amended claim 1 finds support in Table 1 of the specification. Claim 3 has been amended for clarification purposes only. No new matter is believed to have been entered.

§112, 2nd paragraph, Rejection

A. Claims 1 and 3-11 are rejected for being "unclear as how the via holes can penetrate the co-fired aluminum nitride substrate from the front surface to the rear surface when the via holes of the light emitting device are arranged on the front surface of the co-fired aluminum nitride substrate." Applicants traverse this rejection.

Applicants respectfully note that the above quoted interpretation of claim 1 by the Office is incorrect. Claim 1 recites "wherein the light emitting device comprises a vapor-deposited metal film and via holes, the *vapor-deposited metal film* being arranged on the front surface of the co-fired aluminum nitride substrate ..., and the via holes penetrating the co-fired aluminum nitride substrate from the front surface, on which the light emitting device is arranged, to the rear surface of the co-fired aluminum nitride substrate ..." (emphasis added).

In view of this part of claim 1 it is clear that the light emitting device comprises two components, namely a vapor-deposited metal film and via holes, wherein the vapor-deposited film is arranged on the front surface of the co-fired aluminum nitride substrate and wherein the via holes penetrate the co-fired aluminum nitride substrate from the front surface to the rear surface. Accordingly, the Office's assertion that "the *via holes* of the light emitting device are arranged on the front surface of the co-fired aluminum nitride substrate" is mistaken. As such, Applicants request withdrawal of this rejection.

B. Claim 3 is rejected for being "unclear as to whether the one peripheral component is selected from the group consisting of diodes, resistances, and thermistors, wherein the diodes [are] for inhibiting reverse current [or] the one peripheral component is selected from a diode for inhibiting reverse current, a diode for inhibiting resistances, and a diode for inhibiting thermistors." Claim 3 has been amended to clarify that "the at least one peripheral component is selected from the group consisting of a thermistor, a resistor, and a diode for inhibiting reverse current. Accordingly, Applicants request withdrawal of this rejection.

§103(a) Rejections

Claims 1, 4, 5, 8 and 9-11 are rejected as obvious in view of *Hsing Chen* (US 2004/0188696), *Hikasa* (US 5,770,821) and *Durocher* (US 6,614,103). Claim 3 is rejected as obvious in view of *Hsing Chen*, *Hikasa*, *Durocher* and *Nakabayashi* (US 2002/0167017). Claims 6 and 7 are rejected as obvious in view of *Hsing Chen*, *Hikasa*, *Durocher* and *Arai* (US 4,220,810). Applicants respectfully traverse these rejections.

A. Claimed Invention

The claimed invention relates to an apparatus that emits white light, wherein the apparatus has a particular structure such that the reflection efficiency and luminous efficiency of the emitted white light is improved by controlling (i) the surface roughness of the co-fired aluminum nitride substrate, (ii) the materials that make up the vapor-deposited film (i.e., Ag or Al), (iii) the thickness of the vapor-deposited film and (iv) the thickness of the co-fired aluminum nitride substrate.

Furthermore, the Ag or Al metal film of the claimed apparatus, which is formed on the LED-mounting surface of the AlN substrate and has a reflectivity of 90% or more, is used as the reflection film. Accordingly, since said metal film is used as the reflection film of the claimed apparatus, a reflector is not needed. In view of the lack of need for an additional

component/reflector in the present invention, and in view of the lack of wire-bonding (see claim 1 and response filed February 13, 2009), the thickness of the claimed apparatus can be suppressed thereby allowing for the production of a thin-type light emitting apparatus that has a compact size and reduced thickness. However, it should be noted that the claimed apparatus, while having a reduced thickness, maintains a sufficient insulating property and mechanical strength (see further discussion below).

B. *Hsing Chen*

The newly cited *Hsing Chen* reference discloses surface mount LED packages comprising LED dies, sub-mount wafers and via arrays (Abstract). The Office asserts that *Hsing Chen* discloses a LED apparatus comprising an aluminum nitride substrate (1010), a LED (1024) arranged on a front surface (1016) of the aluminum nitride substrate (1010), wherein the LED (1024) comprises a vapor-deposited metal film (1082) and via holes (1014), and the "vapor-deposited metal film [(1082)] being arranged on the front surface of the substrate [(1010)]" (sentence bridging page 3-4 of Office Action). This assertion is incorrect.

Hsing Chen does not disclose a vapor-deposited metal film being arranged on the front surface of the aluminum nitride substrate as claimed by Applicants. Instead, *Hsing Chen* discloses reflector cavities/cups (1080) formed on the front surface of the substrate via cavity wafers (1078), wherein the cavity wafers (1078) form the slanted sides of the cavities (1080) and "a reflective material is applied to the frontside of the cavity wafer (1078) to form reflective layers (1082) on the slanted sides of the cavities (1080) that define the reflector cups" (see [0060] and Figure 12). Accordingly, *Hsing Chen* does not disclose, or depict in the Figures, reflective material applied to the front surface of the aluminum nitride substrate.

In addition, not only is the reflective material applied to a surface other than the front surface of the aluminum nitride substrate, but the reflective material is applied to a surface

that protrudes outwardly from the surface of the substrate, thus increasing the effective thickness of the apparatus (i.e., substrate plus reflector).

In contrast, the thickness of the claimed apparatus is suppressed (thereby allowing for the production of a thin-type light emitting apparatus that has a compact size and reduced thickness) due to the claimed limitations that the metal film has a thickness of 1-5 μm and is formed directly on the front surface of the aluminum nitride substrate which is 0.3-0.6 mm thick (see claim 1).

Accordingly, not only does *Hsing Chen* fail to disclose or suggest a vapor-deposited metal film being arranged on the front surface of the aluminum nitride substrate as claimed by Applicants, but *Hsing Chen* also fails to disclose or suggest a LED apparatus as thin and compact as that claimed.

B. *Hisaka*

Now considering the again cited *Hisaka* reference, Applicants offer the following remarks. *Hisaka* is silent with respect to a vapor-deposited metal film being arranged on the front surface of the co-fired aluminum nitride substrate as claimed by Applicants. Furthermore, the mirror-polished substrate of *Hisaka* that the Office relies upon for its disclosure of a surface roughness of 0.02 μm Ra is noted as having a thickness of 0.2 mm (see col. 8, line 55). Such a substrate thickness as disclosed by *Hisaka* (i.e., 0.2 mm) is (i) not within Applicants' claimed range of 0.3-0.6 mm and (ii) would not have sufficient insulating properties or mechanical strength.

In contrast, the use of an aluminum nitride substrate having a high thermal conductivity and a thickness of 0.3-0.6 mm as claimed, allows for the claimed LED apparatus to have "improved heat radiation performance and can thereby have significantly increased critical currents (maximum passable current, or applicable maximum current quantity) and

dramatically increased emission intensities" while maintaining a sufficient insulating property and mechanical strength (specification: page 13, lines 1-4).

In addition, Applicants again note (see response filed February 13, 2009) that *Hisaka* is also silent with respect to the following claimed feature: the emission of white light. Therefore, not only is *Lee* silent about the particular emission of white light, but by default *Lee's* silence renders non-obvious the following determinations to obtain the claimed apparatus: (1) the desired surface roughness of the aluminum nitride substrate for increasing the emission intensity of the white light, (2) the desired material that makes up the vapor-deposited metal film for effectively reflecting the white light toward the front side of the substrate, (3) the desired thickness of the vapor-deposited metal film for effectively increasing the luminous efficiency of the white light, and (4) the desired thickness of the co-fired aluminum nitride substrate for effectively increasing the heat radiation performance and critical current quantity while maintaining sufficient insulating properties and mechanical strength.

Accordingly, *Hisaka* fails to disclose or suggest (a) a vapor-deposited metal film being arranged on the front surface of the aluminum nitride substrate as claimed by Applicants, and/or (b) a LED apparatus as thin and compact, and as insulating and strong as that claimed.

C. *Durocher*

With respect to the newly cited *Durocher* reference, Applicants note that *Durocher* suffers from the same above-described problems as the *Hsing Chen* reference. More specifically, *Durocher* does not disclose a vapor-deposited metal film being arranged on the front surface of the aluminum nitride substrate as claimed by Applicants. Instead, *Durocher* discloses reflector cavities (35) formed on the front surface of the substrate via side walls (36, 39), wherein the side walls (36, 39) form the slanted sides of the cavities (35) and "the

reflective metal coating is formed on the side walls 36, 39 of the cavities 35" (see col. 7, lines 8-20 and Figure 6). Accordingly, *Durocher* does not disclose, or depict in the Figures, a reflective metal coating applied to the front surface of the aluminum nitride substrate.

In addition, not only is the reflective metal coating applied to a surface other than the front surface of the aluminum nitride substrate, but the reflective metal coating is applied to a surface that protrudes outwardly from the surface of the substrate, thus increasing the effective thickness of the apparatus (i.e., substrate plus reflector).

In contrast, the thickness of the claimed apparatus is suppressed (thereby allowing for the production of a thin-type light emitting apparatus that has a compact size and reduced thickness) due to the claimed limitations that the metal film has a thickness of 1-5 μm and is formed directly on the front surface of the aluminum nitride substrate which is 0.3-0.6 mm thick (see claim 1).

Accordingly, not only does *Durocher* fail to disclose or suggest a vapor-deposited metal film being arranged on the front surface of the aluminum nitride substrate as claimed by Applicants, but *Durocher* also fails to disclose or suggest a LED apparatus as thin and compact as that claimed.

D. Combination of all Cited References

Lastly, *Nakabayashi* and *Arai* are merely relied upon by the Office for their alleged disclosure of certain content of some of the dependent claims. As neither of these references fulfill the deficiencies of *Hsing Chen*, *Hikasa* and/or *Durocher*, and as these three references share the same deficiencies (namely failure to disclose or suggest (a) a vapor-deposited metal film being arranged on the front surface of the aluminum nitride substrate and (b) a LED apparatus as thin and compact, and as insulating and strong, as that claimed), no combination of the cited references render obvious the claimed invention. Accordingly, Applicants request withdrawal of the obviousness rejections of record.

Conclusion

Applicants submit that all now-pending claims are in condition for allowance. Applicants respectfully request the withdrawal of the rejections and passage of this case to issue.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.
Norman F. Oblon

Justine M. Wilbur
Attorney of Record
Registration No. 59,678

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/07)